Project Fact Sheet

Development of a Simple Procedure for Tuning Controller Constants for Automatic Upstream Control of Canal Check Structures

GOALS

- Enable irrigation districts and their consulting engineers to easily automate canal gates for automatic upstream water level control.
- Maintain constant pressure on farmer turnouts.
- Enable irrigation districts to provide more flexible and reliable deliveries to the farm.

PROJECT DESCRIPTION

Perhaps 80% of the irrigation districts in California have
canals; almost 100% of those canals are canals under "manual upstream control". Within the past 10 years, emerging technologies for canal automation have been developed. These include:

- Proportional-Integral (PI) controllers for those canal check gates,
- Improved water level sensors, and
- Supervisory Control and Data Acquisition (SCADA) systems.

Proportional-Integral Controller System

All of these are necessary for automating these control gates so that the irrigation districts can operate with more flexible deliveries while still maintaining the proper water levels in their canals. But what is missing for simple implementation of automatic upstream control is the control logic that must be programmed into the PI controllers (i.e., the on-site computers that are housed at each automatic gate) - the controllers have in them a PI control equation that has 4 "tuning constants". The challenge is in determining the optimum values of those 4 constants. One cannot determine them by "field experience" if there are more than 2-3 check structures in series. Unless the constants are correct, the check gates will cycle too quickly or too slowly, resulting in catastrophic damage to the canal due to overtopping.

BENEFITS TO CALIFORNIA

Successful research will impact numerous energy issues. These include:

- Reduction in groundwater pumping (because surface water deliveries will be more flexible, and water tables will remain at higher levels), thus reducing electricity consumption.

- Elimination of future increases in groundwater pumping which will occur if the present water delivery infrastructure is not significantly improved, thus reducing escalations in energy consumption.
- Increased yield per unit of energy consumed, thus improving efficiency ratios.
- More efficient fertilizer practices, thus reducing indirect energy consumption.
- Planning for water transfers throughout the state.
- Reduced vehicular travel (due to automatic systems and remote monitoring), thus reducing fuel energy use and reducing engine emissions, and
- Reduced deterioration of groundwater quality and quantity.

FUNDING AMOUNT

Contract Funding: $158,800

PROJECT STATUS

- ITRC contracted with Concepts in Controls to provide second complete listing of PLC logic, which will be mapped in a continuing effort to provide better specifications for commercial integrators to follow.
- There is a delayed purchasing of the Dutch simulation program SOBEK until it is capable of simulating composite check structures – those with both underflow and overflow structures in one location.
- Work continues on simulations in refining the tuning mechanism. As CalPoly interacts with integrators and irrigation districts, continually there are new small challenges that arise. For example, Calpoly has changed its procedure for characterizing gate movement, and have added an integration factor to the algorithms.

FOR MORE INFORMATION

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